JobSeekr: A centralized web application for those in the job search
(Technical Paper)

Biased Healthcare Algorithms Built Using Discriminatory Medical Data

(STS Paper)

A Thesis Prospectus Submitted to the

Faculty of the School of Engineering and Applied Science
University of Virginia • Charlottesville, Virginia

In Partial Fulfillment of the Requirements of the Degree
Bachelor of Science, School of Engineering

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Spring, 2021

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On my honor as a University Student, I have neither given nor received
unauthorized aid on this assignment as defined by the Honor Guidelines
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Introduction

Every year new medical technologies are produced to improve healthcare efficiency, but oversights during the development of these technologies often produce new and arguably worse problems. One example is the Electronic Health Record (EHR) system, which is meant to increase efficiency when updating patients' health records, has been shown to drastically increase stress among physicians. Some research shows that "40% of physician burnout is attributable to EHRs" as these systems are unable to "effectively support the dynamic needs of clinicians" (Jason, 2019). Another study shows that many physicians spend "1-2 hours of afterhours work… devoted mostly to EHR tasks" (Sinksy, 2016). These systems were poorly implemented and not properly tested around the actual user, the clinician. Thus, the technical deliverable of this research prospectus will be a proposal of a new EHR, one built around the physicians in order to reduce time spent with healthcare information technology, and increase face-to-face time with patients.

Along with the idea of new technologies creating unforeseen problems, some computer algorithms perpetuate discrimination, from Amazon's AI hiring tool discriminating against women (Hamilton, 2018), or Megvii's gender-recognition software, which was 99% accurate for white men, but only 35% accurate for dark-skinned women (Cossins, 2018). However, there are few discriminatory algorithms that are more life-threatening than those in healthcare. Although these algorithms are intended to treat all patients equally, they do not. One study on a popular algorithm used to allocate resources and additional medical care to patients shows that it is much more likely to recommend white patients over black patients, despite having the same level severity of illnesses (Obermeyer, 2019). The algorithm Obermeyer studied is even race-blind, like many others in order to treat all patients equally, but eliminating discriminatory factors is not

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2 enough and can even be dangerous. This algorithm is just one of many used in healthcare that is meant to create an equitable healthcare system, and since this kind of study is rare due to lack of access to these algorithms and private health data, there may be many more. Thus, the STS portion of this proposal explores how algorithms in the healthcare system perpetuate systematic discrimination.

Technical Prospectus

Physicians across the country are being overburdened by appointments, regulatory work, and updating electronic patient records. While all tasks completed by physicians are important, some have become more complicated than they need to be. Not only does this leave physicians feeling overworked, but it takes away from face-to-face time with patients seeking care. This face-to-face time is the most important task of clinicians because it allows them to diagnose and treat patients' various ailments. One study showed that physicians spend 44.2% of their work time completing EHR tasks such as "clerical and administrative tasks including documentation, order, entry, billing and coding, and system security" (Arndt, 2017). Another study from the University of New Mexico claims that EHR tasks "contribute to approximately 40% of clinician stress" (Jason, 2019), while yet another study reports health information technology-related stress to be prevalent in about 70% of its sampled physicians (Gardner, 2018). All this stress leads to a work-related syndrome known as burnout, which involves "emotional exhaustion, depersonalization, and a sense of reduced personal accomplishment" amongst healthcare workers (West, 2018).

As shown, these tasks take up a huge amount of time and stress, and the number of these tasks will not decrease in the near future. However, one way of reducing stress and burnout 3

within the field of medicine is to create a more efficient and streamlined EHR system, one centered around the user: the physician. Creating the EHR software must take requirements given by both the practice and the physician, tested by the physicians themselves, and updated by listening to their feedback. For example, many clinicians deem electronic notes "as being full of extraneous details, and obscuring important aspects of a patient's condition." A large part of this is due to the fact that most EHR systems started out as billing systems and slowly added features for keeping patient records rather than being built around the physicians' needs (Cimino, 2013). This project will be divided into two parts. The first part will be an analysis of current, popular EHR systems. This analysis will involve literary analysis of research centered around EHR implementation and physicians' interaction with it, as well as direct communication with physicians who feel overburdened by updating EHR's. This research hopes to uncover what clinicians like and dislike about the systems, suggestions on how they should be improved, and why EHRs lead to a more stressful environment in the first place. The second part will be a proposal of a new EHR system that helps reduce the stress associated with updating patient records. This improved EHR will be centered around feedback from physicians using today's EHRs collected from the first part of the technical study. Furthermore, a test plan will be developed so the new system will be tested by the physicians themselves.

STS Prospectus

Discrimination is still a very prominent issue in today's world, including in many computer algorithms. As modern healthcare professionals rely more and more on algorithms to diagnose and treat patients, it is of upmost importance that these technologies not only be accurate, but fair. In a new machine learning algorithm to detect Melanoma, there is increasing 4

"concern if images of skin disease manifesting in darker skin types are not sufficiently included in training algorithms," then people with darker skin will be much more likely to be misdiagnosed (Adamson, 2018). This specific technology is a clear example of bias in medical algorithms, but other algorithms are much more difficult to discern. Ziad Obermeyer, a researcher in machine learning and health-care management, carried out a study that showed "17.7% of patients that the algorithm assigned to receive extra care were black" whereas "the proportion would be 46.5% if the algorithm were unbiased." This staggering difference is healthcare admittance was a result of implicit bias, as the algorithm did not take race into consideration when determining which patients should receive further healthcare (Obermeyer, 2019). A new, colorblind framework designed by D.B. White et al. for allocating ventilators and other resources during the COVID-19 pandemic incorporates a point system based on the overall functionality of patients' vital organs, and their life expectancy. Yet, "because of … historical and epidemiological disparities, the White et al. framework is systematically biased to assign higher scores to Black patients" (Williams, 2020). On a similar note, "racial and ethnic categories [reflects] underlying population genetics and could be clinically useful." In 2005, "the Food and Drug Administration granted a race-specific indication" for a medicine that reduced the mortality rate of heart failure "among patients who identified as black" (Vyas, 2020). In this and other cases, being race-blind could potentially be dangerous. Race-blind algorithms continue to discriminate against race, and the reason lies within the history and the context of the data being fed into healthcare algorithms.

To further understand how healthcare algorithms have gotten to this point, this research will look through the lens of actor-network-theory (ANT). Although there are many slightly differing definitions of this theory, "ANT attempts to… [trace] the complex relationships that 5

exist between governments, technologies, knowledge, texts, money and people" (Cressman, 2009). Since ANT does not have one unanimous definition, critics argue whether or not human and nonhuman actors are equal in importance towards the network (Winner, 1993). This criticism often results in actors having a misrepresented role in the influence of these technologies. Furthermore, ANT will be used not only to analyze the actors within the network, but also the underrepresentation of important actors in the development and progression of these medical technologies, and the role this underrepresentation plays in preserving medical discrimination.

Research Questions and Methods

Methods of documentary research and Wicked Problem Framing will be used in order to answer the question, how do algorithms in the healthcare system perpetuate systematic discrimination. Documentary research will provide evidence and examples of the many biased algorithms within the healthcare system. Additionally, reviewing past research will provide insight and context to what causes discriminatory algorithms and steps towards possible solutions. On the other hand, a big part of the problem is the misunderstanding of the connections of medical data and society. Design theorist Horst Rittel describes characteristics of wicked problems, one of which is that "every wicked problem can be considered to be a symptom of another problem" (Rittel, 1973). As there may be no single solution, Wicked Problem Framing will connect biased healthcare algorithms to the underlying biased data and why that data is biased in the first place, as discriminatory inputs lead to discriminatory outputs. Likely, the most important analysis will be on the data rather than the algorithm itself and then, the relationship between modern, algorithmic systematic discrimination and the data it is based upon can be derived.

Conclusion

The technical component of this paper covers a proposal of a new Electronic Health Record system that reduces the burden on physicians of keeping up with patient records. Although physician burnout is attributed to many factors, the goal of this proposed software system is to eliminate one of the main ones: the stress of keeping up with patient records by building the software around the physician rather than the managerial and billing side of medical practices. On the other hand, the STS portion of this research proposal explores the biases taking place in healthcare algorithms, and how it sustains systematic discrimination within the healthcare system. As shown, black Americans and other people of color are likely to be discriminated against in many medical algorithms, whether to be chosen for further care or to be misdiagnosed, which threaten the lives of minorities. Thus, the goal of this research is to further understand why these algorithms discriminate, how underlying data is discriminatory, and what steps should be taken to create more equitable healthcare technologies.

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